

REMARKS

Claims 1 - 14 are pending in the present application. By this Amendment, claims 1, 3 and 6 have each been amended. No new matter has been added. It is respectfully submitted that this Amendment is fully responsive to the Office Action dated August 2, 2004.

As to the Merits:

As to the merits of this case, the Examiner sets forth the following rejections:

1) claim 1 stands rejected under 35 USC 103 (a) as being unpatentable over Werner et al. (Eavesdropping using quantum-nondemolition measurements);

2) claims 2, 5, 8-11, 13 and 14 stand rejected under 35 USC 103(a) as being unpatentable over Werner et al. in view of Bethune (U.S. Patent No. 6,188,768);

3) claims 3, 4, 6 and 7 stand rejected under 35 USC 103(a) as being unpatentable over Bethune; and

4) claim 12 stands rejected under 35 USC 103(a) as being unpatentable over Werner et al. in view of Bartelt et al. (The Wigner Distribution Function –An Alternative Signal Representation in Optics).

Each of these rejections is respectfully traversed.

Independent Claim 1:

Claim 1, as amended, now calls for *in quantum cipher communication using a light signal, a quantum cipher communication system characterized by the step of detecting eavesdropping based on a change in a quantum-mechanical probability distributions of two amplitude components which are 90 degrees-phase apart from each other measured by a recipient using a difference signal derived from a signal light which change is produced by an eavesdropping operation.*

For example, support for the above amendment to claim 1 is based on the description in the specification, page 21, lines 21 to 23, regarding “to obtain information from both of the two amplitude components which are 90 degrees apart from each other”.

The reference of Werner cited by the Examiner describes a method of QND measurement, calculates the probability that both detectors of the sender and the receiver detect photon as the joint detection probability, and concludes any eavesdropper could be detected by monitoring the extent the data obtained violated the Bell inequality. However, Werner does not teach the features of the method cited in amended claim 1 concerning *detecting eavesdropping based on a change in probability distributions of two amplitude components which are 90 degrees-phase apart from each other.*

The reference of Bartelt cited by the Examiner describes that it is possible to obtain a signal in the time domain and obtain a signal in the frequency domain from a Wigner distribution function, and shows an example of this method applied to a spectrogram of speech by using

optical method. However, Bartelt also does not teach the features of the method cited in amended claim 1 concerning *detecting eavesdropping based on a change in probability distributions of two amplitude components which are 90 degrees-phase apart from each other*.

The reference of Bethune cited by the Examiner describes a quantum cipher communication system operating by photon counting with the two photon detectors D1, D0 shown in FIG. 2 as described in column 7 of the reference, therefore this is the same scheme as Werner's scheme described in the reference Clauser submitted with the accompanying Information Disclosure Statement (IDS) to this Response. In Werner's scheme, the sender and the receiver use photon counting method with photon detectors to count photons. The probability that both detectors of the sender and the receiver detect a photon is the joint detection probability discussed by Werner as described in the reference of Werner cited by the Examiner. This joint probability is fundamentally different from the probability distributions of quadrature-phase amplitude, that is, two amplitude components which are 90 degrees-phase apart from each other, measured by a legitimate receiver using a difference signal derived from a signal light.

Dependent Claim 2 and Independent Claims 3 and 6:

With regard to the features of claims 2, 3 and 6, the Examiner relies on the applied reference of Bethune. However, Bethune is fundamentally different from the claimed invention set forth in claims 2, 3 and 6, since Bethune is not concerned with splitting a light signal from a transmission source side into an intense reference signal and a weak transmission signal which is so weak that a change in its quantum mechanical state is detectable.

Instead, Bethune discloses in Fig. 2 that both of the pulses P1 and P2 pass through an attenuator 24. In other words, in Bethune each of the pulses P1 and P2 would have the same weak intensity. More specifically, according to Bethune, “the two pluses P1, P2 then travel through the fiber-optic link 30 and pass through an attenuator 24 at the second channel end 20. The attenuator 24 may be a conventional 2x2 fiber optic coupler that allows only a small percentage, e.g., 5%, of the input light to pass, or a fixed attenuator, which may be a short break in the optical fiber that allows a large percentage of the light to be scattered.”¹

This is in complete contrast to the present invention wherein only the transmission signal, and not the reference signal, is passed through an attenuator thereby creating an intense reference signal and a weak transmission signal which is so weak that a change in its quantum mechanical state is detectable.

For example, as shown in Fig. 1 of the present application, the light attenuator 4 is used to attenuate only the quantum signal light S to an extent that it has a typical intensity which is so weak as it corresponds to a single photon or so and such that a change in its quantum mechanical state is detectable.

Based on the above, it is clear that Bethune fails to disclose or fairly suggest the features of claim 2 concerning *splitting a light signal from a transmission source side into an intense reference signal and a weak transmission signal which is so weak that a change in its quantum mechanical state is detectable*.

¹ Please see, lines 45-51, column 5 of Bethune.

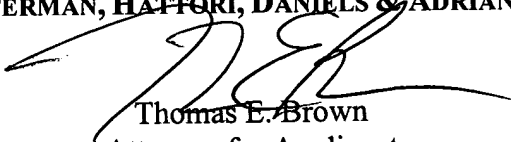
With regard to independent claims 3 and 6, each of these claims have been amended to recite *a light attenuator for converting only said transmission signal into a weak transmission signal which is so weak that a change in its quantum state is detectable*, in order to clearly distinguish over Bethune, which discloses that both of the pulses P1 and P2 pass through an attenuator 24.

In view of the aforementioned amendments and accompanying remarks, Applicant submits that that the claims, as herein amended, are in condition for allowance. Applicant requests such action at an early date. If the Examiner believes that this application is not now in condition for allowance, the Examiner is requested to contact Applicant's undersigned attorney to arrange for an interview to expedite the disposition of this case.

If this paper is not timely filed, Applicant respectfully petitions for an appropriate extension of time. The fees for such an extension or any other fees that may be due with respect to this paper may be charged to Deposit Account No. 50-2866.

Respectfully submitted,

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